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Institute for Advanced Biosciences, Keio University

A New Species of Tardigrade, “*Macrobiotus shonaicus*,” Discovered in Tsuruoka City, Yamagata Prefecture

Together with Associate Professor Łukasz Michalczyk of Jagiellonian University in Poland and other researchers, Associate Professor Kazuharu Arakawa (Faculty of Environment and Information Studies) of the Institute for Advanced Biosciences, Keio University (Tsuruoka City, Yamagata Prefecture; Director General: Professor Masaru Tomita) discovered a new species of tardigrade in Tsuruoka City, Yamagata Prefecture, and named it “*Macrobiotus shonaicus*.” Tardigrades have been studied for over 100 years in Japan, but there have been relatively few cases of new species being discovered in the country, and this is the first time a species has been found in Yamagata Prefecture. This discovery was presented at 14:00 on February 28, 2018 (4:00 on March 1, Japan time) on the online version of the American scientific journal PLOS ONE.

Tardigrades are microscopic animals of 1 mm or less in size, harmless to humans, and can be found in your close surroundings if you have a microscope. One of the most interesting characteristics of tardigrades, which has gathered much attention, is their ability to almost completely dehydrate themselves as the surrounding environment dries and reduce their metabolic activity to an undetectable level, a state known as anhydrobiosis. Through this, they can survive extreme environments including extremely low temperatures, radiation, and even exposure to outer space. On hydration, these tardigrades can immediately return to an animated state, even after long-term storage lasting numerous years.

Tardigrades were first discovered in the 18th century, and today there are about 1,200 known species in the world. Tardigrades have long been researched in Japan, with 167 species having been identified since the beginning of the 20th century. However, the number of species newly discovered in Japan is limited to just 26. Of these, 9 species live in the ocean while 17 dwell on land.

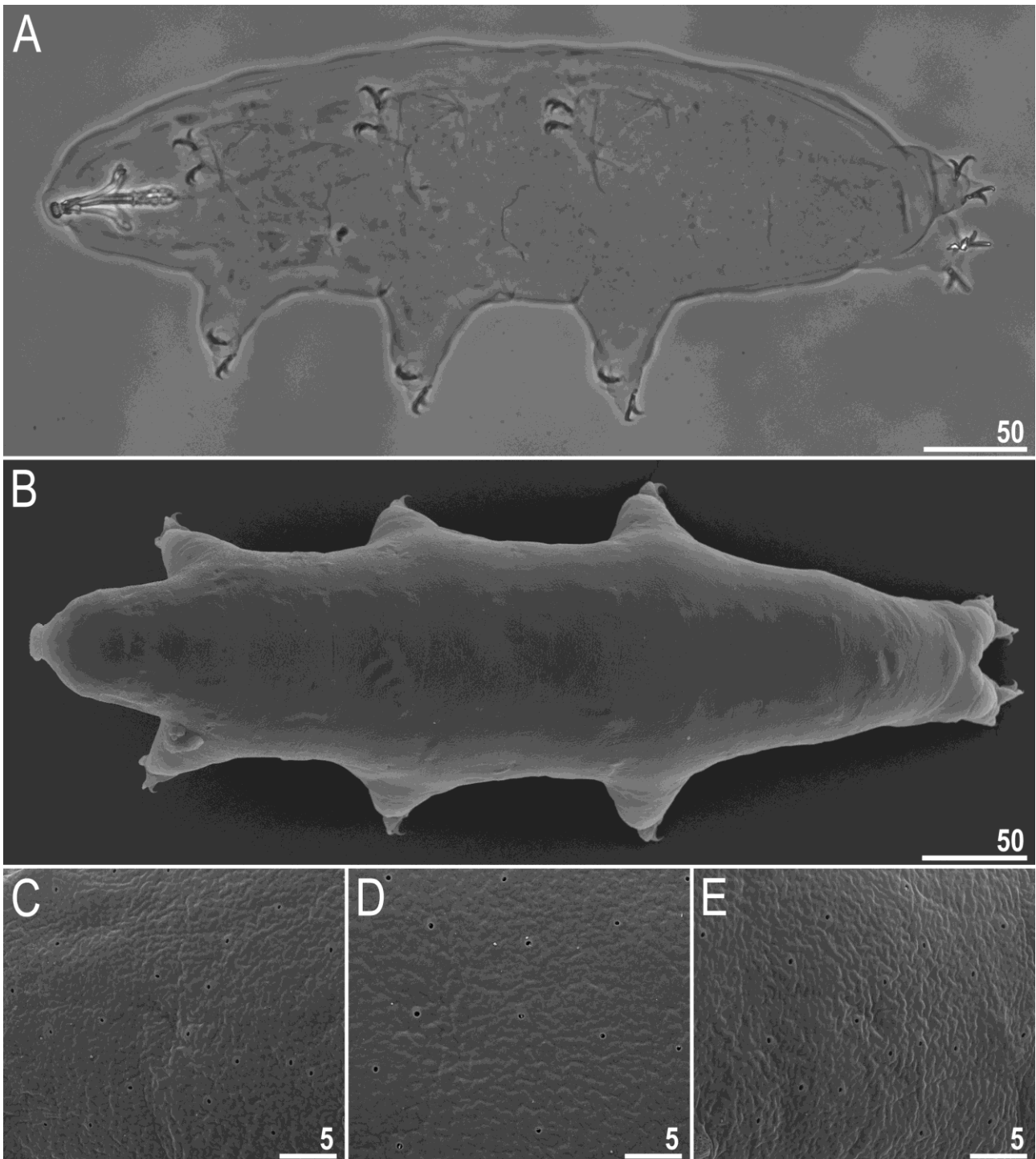
Associate Professor Arakawa and other researchers discovered a new tardigrade species of the Macrobiotidae family on moss growing on concrete in the urban area of Otsuka-machi in Tsuruoka City, Yamagata Prefecture. The name Macrobiotidae was given to these creatures that live for many years through anhydrobiosis when the species was documented for the first time in 1834. The newly discovered *Macrobiotus shonaicus* has a shape very similar to *Macrobiotus hufelandi*, the species discovered in Germany in 1834. However, characteristics such as the cuticular pores covering the surface of the body being decisively smaller, bulges on the three front pairs of its legs, and the flexible filaments with smooth surfaces covering the eggs, distinguish

Macrobiotus shonaicus from *Macrobiotus hufelandi*. Furthermore, genetic analysis showed that the sequences of the 18S rRNA and 28S rRNA of the genome and the COI mitochondrial gene for this species had not been previously published, leading to the conclusion that this was a new species of tardigrade.

As this species of tardigrade was first discovered in the Shonai region in Yamagata Prefecture, Associate Professor Arakawa and the other researchers decided to name it *Macrobiotus shonaicus*. They have developed a method to breed the tardigrades and are carrying out genetic analysis of these creatures. Molecular biological research on tardigrades until now has focused mostly on the Hypsibiidae family. It is hoped that progresses in research on the Macrobiotidae family will greatly add to our understanding of the tardigrades' ability to survive extreme environments. Moreover, tardigrades such as those in the Hypsibiidae family reproduce asexually, meaning only females of the species exist. However, as both males and females of the *Macrobiotus shonaicus* species are found, there is much anticipation to study these species to understand how tardigrades reproduce.

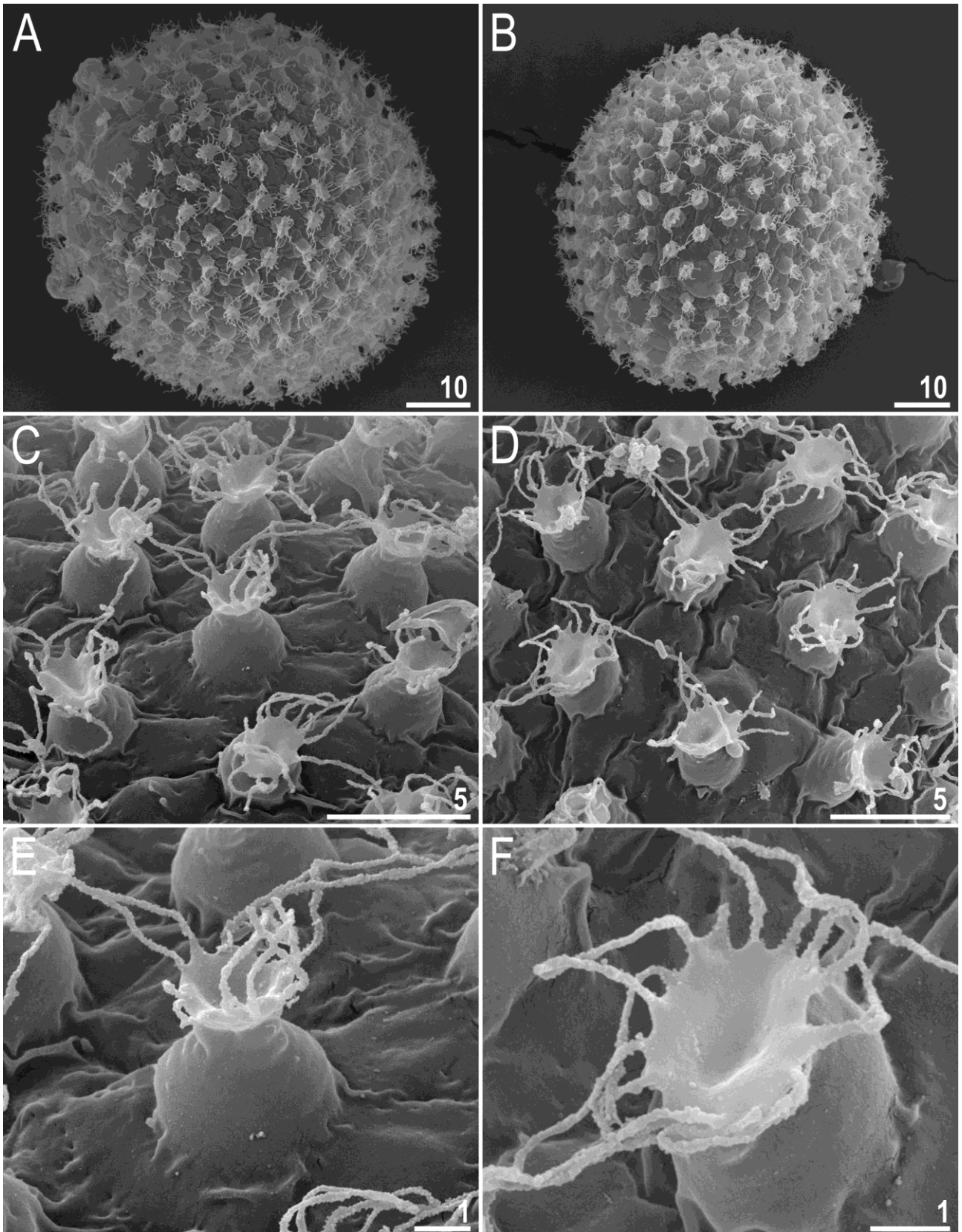
When presenting their paper, Associate Professor Arakawa mentioned having found *Macrobiotus shonaicus* in the parking lot of the Otsuka-machi apartment where he used to live. He commented on his own surprise at finding a new species in his own backyard, but says that it may be a good example of the presence of a rich ecosystem in Shonai. He hopes that research into this species that carries the name of the Shonai region will spread widely across the world.

<Electron microscope images of *Macrobiotus shonaicus*>



↑ A: Optical microscope; B: full image under an electron microscope; C, D, and E: cuticular pores on the surface of the body (all measurements are in μm)

<*Macrobiotus shonaicus* eggs>



Electron microscope images showing flexible filaments with smooth surfaces that covers the eggs of the *Macrobiotus shonaicus*. (Measurements are in μm.) Many eggs of the other *M. hufelandi* group tardigrade species are covered with filaments with disc-shaped tips that resemble mushrooms.

Original paper: Stec D, Arakawa K, Michalczyk Ł, “An integrative description of *Macrobiotus shonaicus* sp. nov. (Tardigrada: Macrobiotidae) from Japan, with notes on its phylogenetic position within the hufelandi group,” PLOS ONE, In press.

Video: Videos of *Macrobiotus shonaicus* can be viewed at the following website:
<http://www.iab.keio.ac.jp/en/news-events/news/>

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